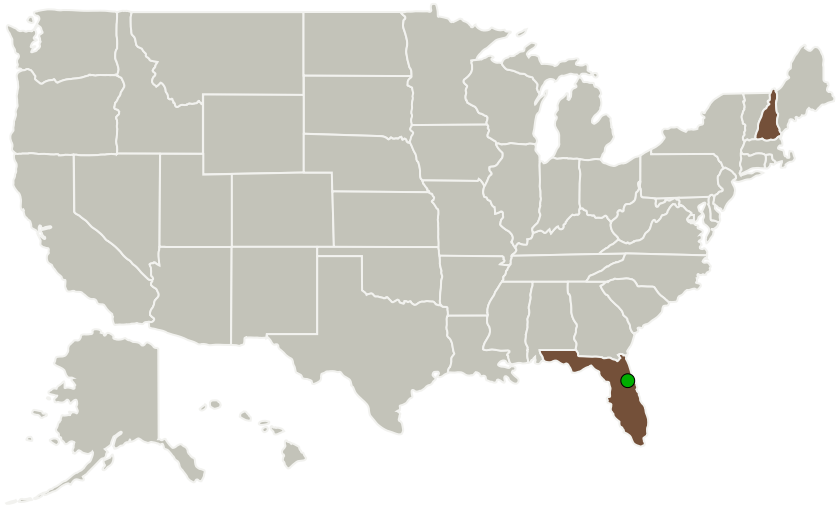
An Advanced Wet Expansion Turbine for Hydrogen Liquefaction, Phase I

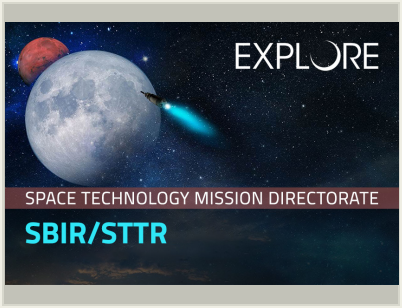
Completed Technology Project (2011 - 2011)

Project Introduction

This proposal is responsive to NASA SBIR Topic X10.01, specifically, the need for efficient small- to medium-scale hydrogen liquefaction technologies including domestically produced wet cryogenic turboexpanders. Future NASA missions will require hydrogen liquefaction systems for earth-based, planetary, and lunar surface missions. A critical part of these systems is the cryogenic turboexpanders, which must be designed for high-speed operation and long life, and must be robust against the pressure and momentum excursions and the surface tension effects associated with two-phase flow. On this Phase I/II program, Creare will build and test a cryogenic turboexpander for use in a hydrogen liquefier. The turboexpander will be reliable, compact, lightweight, and efficient and will be able to operate in a two-phase system. We have prior experience in designing and building wet turboexpanders for terrestrial applications as well as small turbomachines for space applications. We plan to leverage this experience to build for NASA a wet turboexpander suitable for operation in both terrestrial and space environments. Our turboexpander will have the innovative option of recovering the expansion work through use of an alternator (i.e., turboalternator) instead of dissipating work using a brake wheel. This approach greatly simplifies controls, improves reliability, and reduces system mass and input power. During the Phase I project, we will optimize the design of the turboexpander for a specific application selected by NASA. On the Phase II project, we will build and test the turboexpander.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Creare LLC	Lead Organization	Industry	Hanover, New Hampshire
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations	
Florida	New Hampshire

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140219)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Creare LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Mark Zagarola

Co-Investigator:

Mark Zagarola

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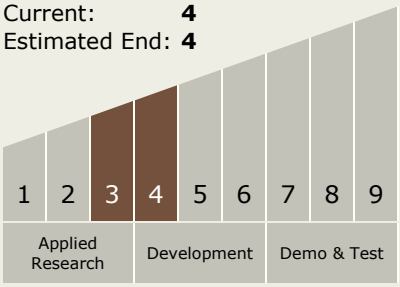
Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.3 Cryogenic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System